

PATENT COOPERATION TREATY
PCT
INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)
(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference PP0502	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. PCT/AU2004/001040	International filing date (<i>day/month/year</i>) 5 August 2004	Priority date (<i>day/month/year</i>) 5 August 2003
International Patent Classification (IPC) or national classification and IPC Int. Cl. ⁷ A01C 7/04, 7/20		
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1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (*sent to the applicant and to the International Bureau*) a total of 12 sheets, as follows:

☐ sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:
- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

Date of submission of the demand 1 March 2005	Date of completion of the report 28 November 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer A. SEN Telephone No. (02) 6283

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/AU2004/001040

Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on translations from the original language into the following language which is the language of a translation furnished for the purposes of:

☐ international search (under Rules 12.3 and 23.1 (b))

☐ publication of the international application (under Rule 12.4)

☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

☐ the international application as originally filed/furnished

☒ the description:

pages 1-3, 5-34 as originally filed/furnished

pages* 4, 4a, 4b, 35, 36 received by this Authority on 18 November 2005 with the letter of 18 November 2005

pages* received by this Authority on with the letter of

☒ the claims:

pages as originally filed/furnished

pages* as amended (together with any statement) under Article 19

pages* 37-43 received by this Authority on 18 November 2005 with the letter of 18 November 2005

pages* received by this Authority on with the letter of

☒ the drawings:

pages 1/12-12/12 as originally filed/furnished

pages* received by this Authority on with the letter of

pages* received by this Authority on with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (*specify*):

☐ any table(s) related to the sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/figs

☐ the sequence listing (*specify*):

☐ any table(s) related to the sequence listing (*specify*):

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/AU2004/001040

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-32	YES
	Claims	NO
Inventive step (IS)	Claims 1-32	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-32	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

Claims 1-32 meet the criteria set forth in PCT Article 33(2)-(4) for novelty, inventive step and industrial applicability. The prior art published before the priority date does not disclose a seeding apparatus/method comprising a rotatable seed metering element, means for rotating the metering element, vacuum generating means, feed system, release means and delivery means wherein the metering element is a drum and the seeds are accelerated and thereafter placed adjacent to the metering apertures on the surface of the drum at a controlled speed.

using rotating drums or discs pick up individual stationary seeds from a pick-up area and rotate the seeds to a spaced drop off location. This can only be achieved at relatively low rotation speeds. At higher speeds the moving drum or disc surface passes the stationary seeds in the pickup zone too quickly to
5 pick up the seed. Therefore the majority of these vacuum planter machines are limited to maximum sowing ground speeds of about 12 to 15 kilometres per hour.

It is therefore a first object of the invention to improve maximum yield by
10 providing a seed distribution method and apparatus which improves the micro growing location by lowering the percentage of overpopulated or underpopulated seed density.

It is a second object of the invention to provide a method of seed distribution
15 and a seeding apparatus, which allows accurate faster seeding than the above conventional means.

It is a third object of the invention to provide a method for the placement of the individual seeds within each row at a selected spacing together with the ability
20 to space multiple rows each at a selected distance apart, both these being variable and easily changed, to provide numerous sowing grid options.

It is a fourth object of the invention to provide an apparatus which can place predominantly individual seeds at considerable speed enabling the rapid
25 sowing of a grid pattern which gives the optimum plant population outcome required for a particular crop.

It is a further object of the invention to provide an improved method of seed distribution and a seeding apparatus, which overcomes or at least ameliorates
30 the problems of the prior art.

SUMMARY OF THE INVENTION

According to the invention there is provided in one aspect seeding apparatus for metering and delivering seeds for planting in a seedbed, comprising:

- a rotatable seed metering element having a row of circumferentially spaced apart apertures on a rotating surface of the metering element;
vacuum generating means arranged to draw air inwardly through said apertures whereby to attract and hold seeds to said apertures; and
5 means for rotating said metering element,
a feed system for transporting seed from a seed reservoir to said metering element and placing said seed at said rotating surface so that seeds are attracted to and held at said apertures;
release means at a release point on the metering element for releasing seeds
10 held at each said aperture of said rotating surface and carried to said release point; and
delivery means for delivering said seeds to a seedbed,
wherein —
(a) the metering element comprises a drum, the said rotating surface being
15 an external cylindrical surface of the drum; and
(b) in the feed system seeds are accelerated to an increased speed and thereafter placed adjacent to the surface of the drum and the metering apertures at a controlled speed.
- 20 In another aspect, the invention provides a method for metering and delivering seeds for planting in a seedbed including the steps of:
providing a rotatable seed metering element having a row of circumferentially spaced apart apertures on a rotating surface of the metering element;
providing vacuum generating means arranged to draw air inwardly through
25 said apertures whereby to attract and hold seeds to said apertures;
rotating said metering element,
by means of a feed system delivering seed from a seed reservoir to said metering element and placing said seed at said rotating surface so that seeds are attracted to and held at said apertures;
30 at a release point on the metering element releasing the seeds held at each said aperture and carried to said release point whereby to form a metered stream of seeds; and
delivering said metered stream of seeds to a seedbed,
wherein:

- (a) the metering element comprises a drum, the said rotating surface being an external cylindrical surface of the drum; and
- (b) the method includes the step of accelerating seed in the feed system to an increased speed and thereafter placing the seed adjacent to the
5 surface of the drum and the metering apertures at a controlled speed.

More generally, there is provided a method of seed distribution and a seeding apparatus for achieving this, which includes a seed feed system and a moving

the tube can be dissipated 55 before it reaches the roller thereby preventing the seeds from being blown out from under the roller. The momentum of the seeds will enable an accurate placement 57 of each row of seeds under the front roller thereby minimizing seed bounce and maintaining accurate seed placement.

The ground ticklers 54 which can be of one of many shapes such as spring tynes, are attached to the support frame and the depth and angle – variable aggression action – is set to provide the necessary soil movement required to mix in and thereby incorporate the seeds. The ticklers are spaced on the support frame to maximize the required outcome while minimizing a raking of trash. The back roller which can also be shaped to provide the required outcome presses the soil and seed together and expels excess air from the soil surface thereby assisting germination. By setting the tips of the ground ticklers to for example 20 millimetres, it would be difficult to bury the seeds any deeper than 20 millimetres.

Figure 24 shows a variation of the two roller unit above the seeds being shot 61 into the soil 58 which has been fluffed up by the ground ticklers 54 and the depth of seed placement being determined by the tickler setting as well as the exit momentum of the seeds. However too much momentum at an incorrect angle would create seed bounce, which is undesirable.

The seeding apparatus preferably includes a supporting means in which the drum, the acceleration means and receiver hopper are maintained substantially level. The supporting means may be a platform having hydraulic rams to provide self leveling of the platform.

The acceleration means of the seeding apparatus may include an air jet for blowing seed out along a close circumferential or tangential path at a speed substantially equal to the drum surface speed.

It should be understood that the above description is not limiting of the invention. Clearly other variations, which are understood by a person skilled in

the art without any inventive element, are included within the scope of this invention as defined within the scope of the following claims.

CLAIMS

1. Seeding apparatus for metering and delivering seeds for planting in a seedbed, comprising:

5

a rotatable seed metering element having a row of circumferentially spaced apart apertures on a rotating surface of the metering element;

10

vacuum generating means arranged to draw air inwardly through said apertures whereby to attract and hold seeds to said apertures; and

means for rotating said metering element,

15

a feed system for transporting seed from a seed reservoir to said metering element and placing said seed at said rotating surface so that seeds are attracted to and held at said apertures;

20

release means at a release point on the metering element for releasing seeds held at each said aperture of said rotating surface and carried to said release point; and

delivery means for delivering said seeds to a seedbed,

wherein —

25

(a) the metering element comprises a drum, the said rotating surface being an external cylindrical surface of the drum; and

30

(b) in the feed system seeds are accelerated to an increased speed and thereafter placed adjacent to the surface of the drum and the metering apertures at a controlled speed.

2. Seeding apparatus according to claim 1 wherein the feed system comprises flow rate control means whereby seed is fed at a controlled flow rate from said reservoir to the drum.
- 5 3. Seeding apparatus according to claim 1 wherein the velocity of seeds placed adjacent to the row of apertures is controlled to be approximately the same as the speed of the apertures.
- 10 4. Seeding apparatus according to claim 2 wherein the flow rate control means comprises a variable restriction to flow of seed into the feed system.
- 15 5. Seeding apparatus according to claim 1 wherein the feed system comprises:
acceleration means whereby seed entering the feed means is accelerated to a speed approximately the speed of the cylindrical surface of the drum; and
20 velocity control means whereby seed leaving the acceleration means is placed adjacent to the row of apertures and its speed is controlled.
- 25 6. Seeding apparatus according to claim 5 wherein the acceleration means comprises a chamber in which seed falls downward whereby to be accelerated to an increased speed by the action of gravity on the seed.
- 30 7. Seeding apparatus according to claim 6 further comprising supporting means for maintaining the drum and the acceleration means substantially level in use.
8. Seeding apparatus according to claim 6 wherein the acceleration means further comprises means for redirecting seed reaching a lower

part of the chamber into a direction approximately tangential to the drum surface.

- 5 9. Seeding apparatus according to claim 5 wherein the velocity control means comprises at least one moving belt that engages seed leaving the acceleration means the belt being of controllable speed.
- 10 10. Seeding apparatus according to claim 9 wherein seed passes between the or a said belt and the surface of the drum over a portion of the circumference of the drum.
- 15 11. Seeding apparatus according to claim 5 wherein the velocity control means comprises an adjustable flap and wherein seed passes between the flap and the surface of the drum over a portion of the circumference of the drum.
- 20 12. Seeding apparatus according to claim 5 wherein the velocity control means comprises a rotating roller whose speed and direction of rotation are controllable and wherein seed leaving the acceleration means passes between the roller and the surface of the drum.
- 25 13. Seeding apparatus according to claim 5 wherein the velocity control means comprises one or more of a: a moving belt; a rotating roller; and an adjustable flap engaging seed that leaves the acceleration means whereby to control the speed of the said seed leaving the acceleration means.
- 30 14. Seeding apparatus according to claim 5 wherein the feed system includes an air jet for blowing seed along a path that passes close to the surface of the drum and accelerates the seed to a speed substantially equal to the speed of the surface of the drum.
15. Seeding apparatus according to claim 1 wherein:

- (a) the feed system places seeds adjacent to the drum surface and apertures over a portion of its circumference;
- 5 (b) the release point is circumferentially past the said portion so that seeds held at the apertures are carried beyond the said portion to the release point and at the release point released in a metered seed stream, and
- 10 (c) the said portion and the said release point are so positioned that seeds not held at the apertures leave the drum surface in an unmetered seed stream separate from the metered seed stream before reaching the said release point.
- 15 16. Seeding apparatus according to claim 15 further comprising recycling means for capturing the unmetered seed stream and returning the unmetered seed to the seed reservoir.
- 20 17. Seeding apparatus according to claim 1 wherein the release means comprises an air jet nozzle directing an air jet to eject metered seeds off the drum.
- 25 18. Seeding apparatus according to claim 1 further comprising means for controlling the speed of seeds released from the drum by the release means.
- 30 19. Seeding apparatus according to claim 1 wherein seeds ejected from the delivery means are directed under a roller rolling on the seedbed whereby to limit seed bounce on the seedbed.
20. Seeding apparatus according to claim 1 having electronic sensing means at a point of exit of metered seeds from the delivery system, the sensing means providing output adapted for at least one of:

- (a) establishing exit speed of seeds from the delivery system for the purpose of controlling the seed exit speed and/or the depth of planting of seeds in the seedbed;
- 5 (b) counting seeds delivered;
- (c) monitoring for blockage of the delivery system.
21. Seeding apparatus according to claim 1 wherein the row of apertures
10 is one of a plurality of rows of apertures on the drum and wherein the delivery means is adapted to deliver a metered seed stream from each row of apertures to one of a plurality of transversely spaced-apart rows.
- 15 22. Seeding apparatus according to claim 1 further comprising control means adapted to control at least drum rotation speed, flow rate of seed in the feed system, and seed velocity at the drum surface whereby to provide a selected seed delivery rate related to ground speed and required seed spacing.
- 20 23. Seeding apparatus according to claim 21 wherein said control means further controls speed of exit of metered seeds from the delivery system.
- 25 24. A method for metering and delivering seeds for planting in a seedbed including the steps of:
- 30 providing a rotatable seed metering element having a row of circumferentially spaced apart apertures on a rotating surface of the metering element;
- providing vacuum generating means arranged to draw air inwardly through said apertures whereby to attract and hold seeds to said apertures;

rotating said metering element,

5 by means of a feed system delivering seed from a seed reservoir to
said metering element and placing said seed at said rotating surface
so that seeds are attracted to and held at said apertures;

10 at a release point on the metering element releasing the seeds held at
each said aperture and carried to said release point whereby to form a
metered stream of seeds; and

delivering said metered stream of seeds to a seedbed,

15 wherein:

(a) the metering element comprises a drum, the said rotating
surface being an external cylindrical surface of the drum; and

20 (b) the method includes the step of accelerating seed in the feed
system to an increased speed and thereafter placing the seed
adjacent to the surface of the drum and the metering apertures
at a controlled speed.

25 25. A method according to claim 24 including the step of controlling the
flow rate of seed that is delivered to the feed system and thence to the
drum.

30 26. A method according to claim 24 wherein the controlled speed at which
seed is placed adjacent to the drum surface and apertures is
approximately the same as the surface speed of the drum.

27. A method according to claim 24 wherein seeds entering the feed
system are accelerated by falling through a vertical distance so as to
be acted on by gravity.

28. A method according to claim 24 wherein seed placed adjacent to the drum surface is maintained adjacent to the drum surface over a portion of the drum surface circumference.
- 5
29. A method according to claim 28 wherein:
- (a) the release point is circumferentially past the said portion so that seeds held at the apertures are carried beyond the said portion to the release point and at the release point released in a metered seed stream, and
- 10
- (b) the said portion and the said release point are so positioned that seeds not held at the apertures leave the drum surface in an unmetered seed stream separate from the metered seed stream before reaching the said release point.
- 15
30. A method according to claim 28 including the step of capturing the unmetered seed stream and returning the unmetered seed stream to the seed reservoir.
- 20
31. A method according to claim 24 wherein delivery of the metered stream of seeds is by a delivery system and the speed of exit of seeds from the delivery system is controlled.
- 25
32. A method according to claim 24 wherein seeds are metered at a rate sufficient for seed placement at a selectable along-row seed spacing and at a ground speed substantially greater than 20 kilometres per hour, preferably between 30 and 60 kilometres per hour.